Vol. V. No. XCVIII.] MARCH 1, 1877. [Price Fourpence.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

LONDON: HAUGHTON & COMPANY, 10, PATERNOSTER ROW, E.C.
New York: D. Van Nostrand, 23, Murray Street, and 27, Warren Street. Paris: M. Breguet, 39, Quai de l'Horloge: Madame Veuve J. Boyveau, Librarie Etrangère, 22, Rue de la Banque.
Berlin: A. Asher & Co., 5, Unter der Linden.

NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'s PATENT COPPER-ROPE LIGHTNING-CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest Conductor offered to the public.

It is simple in its application, no insulators being required; and it costs only One Shilling per foot for the standard size, which is safe in any storm.

Sole Patentees of Untwisted Wire Rope. Manufacturers of Iron and Steel Ropes for Colliery and Railway Purposes. Rigging Ropes, Guide Ropes, &c.
Gilt and Silver Cord for hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

R. S. NEWALL & Co., LONDON, 130, STRAND, W.C.
LIVERPOOL, 36, Waterloo Road; GLASGOW, 68, Anderston Quay; MANUFACTORY, Gateshead-on-Tyne.

ZIMDARS' PATENT

PNEUMATIC BELLS,
DESPATCH TUBES,
SPEAKING TUBES,
ELECTRIC BELLS.

C. E. ZIMDARS,

327, Gray's-Inn Road, W.C.

LIGHTNING-CONDUCTORS, &c., &c.—DIXON, CORBITT, & SPENCER, Manufacturers of Hemp, Manilla, and Wire Ropes of every description; Lines, Twines; Copper, Iron, and Steel Cords for Sash-lines and other purposes; Gilt and Silver Cord for Hanging Pictures; Fencing Strand; Copper-rope Lightning-Conductors; Spinners of Yarn for Submarine Telegraphs, &c. Warehouse removed from 103, Fenchurch-street, E.C., to 26, Commercial Road, East. Works: Gateshead-on-Tyne.

REDUCTION OF TARIFF ON TELEGRAMS TO AMERICA.

ANGLO-AMERICAN TELEGRAPH CO., LIMITED.

On and after 1st MARCH, 1877, the charge for the Transmission of Messages by the Cables of the Anglo-American Telegraph Company, Limited, to New York and Canada will be reduced to

ONE SHILLING PER WORD.

The Addresses of Persons and Firms Registered with this Company will be Transmitted Free of Charge. For Charges to other Places, and furthur particulars, apply at the Offices of the Company, 23, Throgmorton Street, London, or at any Postal Telegraph Office.

General Offices of the Company, 26, Old Broad-street, London, E.C.
23rd February, 1877.

THE EXCHANGE TELEGRAPH COMPANY, LIMITED.

(*Incorporated* 1872,
Under the Companies Acts, and a special license from Her Majesty's Postmaster-General.)

Capital, £225,000.

HEAD OFFICES, 17 AND 18, CORNHILL, LONDON, E.C.

This Company is now establishing branch offices or call stations throughout the metropolis and suburbs for the due administration of its

TELEGRAPHIC CALL SYSTEM,

by the aid of which subscribers may be enabled at any hour of the

DAY OR NIGHT

TO CALL A

MESSENGER, CAB, OR POLICEMAN,

AND GIVE THE

ALARM OF FIRE,

while many other "Calls" indicating the wants of a private house, chambers, office, or place of business of any kind may be arranged for, all such being made in the same uniform manner by the pressure of a button on a small automatic instrument, placed as most convenient and telegraphically connected with the nearest "Call Station" of the Company, which in no case will be distant from the subscriber more than a quarter of a mile or three minutes' time; these instruments occupy but a few inches of space, are not liable to get out of order, require no local batteries or winding up, and no knowledge whatever of telegraphy to work them.

CALL STATIONS

will be established wherever a demand for them may arise; they will be provided with a permanent staff of operators and messengers, whose duty it will be to receive and attend to "Calls." A policeman will be found there, and an expert with a hand pump or extincteur ready to act on the first alarm of fire, and each station will be in telegraphic communication with the nearest

POLICE AND FIRE BRIGADE STATIONS,

thus enhancing the public value of the system by the increased security which will be rendered to life and property.

The system has been in operation in the United States for some years past, having been initiated and established by the American District Telegraph Company to meet a great public want, and where its practical advantages have become so fully recognised and appreciated that it is being rapidly adopted throughout the States; in New York, where it originated, and some thousands of instruments are at work, it is considered indispensable as

THE HOME TELEGRAPH.

A PROTECTION TO LIFE AND PROPERTY—A CONVENIENCE IN DOMESTIC LIFE,
AND AN ADJUNCT TO BUSINESS.

DAY SERVICES,

chiefly for the purpose of utilising the Messenger Service, will be established in business localities.

TERMS FOR A SINGLE INSTRUMENT:

Day and Night Service .. .. 5 Guineas per annum. Day Service .. .. 4 Guineas per annum.

Extra Instruments at a reduction.

Instruments placed and connected with the nearest Call Station of the Company, and kept in working order free of all charge to subscribers.

Messengers when employed Sixpence to Eightpence per hour.

Automatic, Fire, and Burglar Alarms fitted in conjunction with the Call System.

For further particulars apply to the SECRETARY at the above address.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. V. MARCH 1, 1877. No. XCVIII.

CONTENTS:

PAGE
Amalgamation *v.* Independence (*four tables*) ... 49
Report of the Royal Commission on Railway Accidents ... 51
Fuller's Mercury-Bichromate Battery (*with figure*) ... 52
Notes ... 54
City Notes ... 55
PROCEEDINGS OF SOCIETIES:
The Royal Society ... 56
The Society of Telegraph Engineers. 58
Physical Society ... 60

TO INVENTORS.

MESSRS. BREWER & JENSEN, British, Foreign, and Colonial Patent Agents, give prompt personal attention to all matters entrusted to them. Office for Patents, 33, Chancery Lane, W.C. Established 1844.

PATENTS FOR INVENTIONS.

ROBERTSON, BROMAN & Co. (established 50 years) continue to obtain Patents for Inventions. Pamphlet, containing special advice, gratis or by post. 166, Fleet-street, London.

H. M. CAPNER, Manufacturer of Electrical-Galvanic, and Philosophical Apparatus of every description.—20, Northampton-square, Clerkenwell, E.C.

HUGHES' TYPE-PRINTING TELEGRAPH INSTRUMENTS.

TWO of these Instruments in good working order for sale. Apply to C., care of Mr. HICKS, 8, Hatton Garden, London.

GREVILLE'S AUSTRALIAN TELEGRAM Company. London offices, 9A, New Broad-street, City, E.C.

AUSTRALIAN OFFICES.
Melbourne—Greville's Exchange, Collins'-street.
Sydney—Greville's Commercial Room, George-street.
Adelaide—South Australia.
Brisbane—Queensland.

This Company receives and despatches messages for any parts of Australia at the lowest rates. For particulars apply to the Managing Director, at the above address, 9A, New Broad-street, London, E.C.

TELEGRAMS.—The Oriental and American Telegram Company (Limited), 140, Leadenhall-street, having, from the 1st December, 1876, taken over the business of Flamant's North American Agency, are now prepared to receive and despatch Messages to NORTH AMERICA, South America, India, China, Australia, &c. Registered Clients effect a considerable saving through this Company. No charge made for Registration. (See Tariffs.) Messages for all parts are received at the Offices of the Company, 140, Leadenhall-street, E.C., and forwarded with the utmost despatch. OTTO ROCHS, Managing Director.

BLOCK TELEGRAPHS AND ELECTRIC INTERLOCKING SIGNALS.

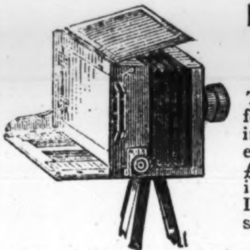
TYER & COMPANY

Respectfully invite the attention of Railway Directors, Managers, and Engineers to their important improvements in "Block" Telegraphs, especially to their new system (Patent 1874, in conjunction with Messrs. SAXBY & FARMER), inspected and improved by Captain TYLER, on behalf of the Board of Trade. By the use of this appliance, a signalman who receives a telegraphic indication of a line blocked, from the signalman in advance, cannot possibly give a contrary signal upon the outside semaphore to the engine-driver.

"Such is the latest development of railway signalling, which is worthy of careful attention, constituting, as it does, a marked advance upon the ordinary block system."—*The Times.*

Office and Works—4, OLD STREET, GOSWELL ROAD, LONDON.

C.



PHOTOGRAPHY
(RAPID DRY PROCESS.)
Previous Knowledge not Necessary.

No Chemicals required in the Field. Tourists' Pocket Camera and Slides, for Plates, 5 by 4, Lens, Patent Folding Stand, Chemical Laboratory, and every requisite. Price complete, £9 9s. 0d. Full particulars and instructions free by Post, or Practical Lessons free on the Premises. Sensitive Plates, 5s. 6d. per doz.

The above set of Apparatus is recommended to the particular attention of Engineers, Explorers, and Tourists, who would find a knowledge of practical Photography easy to acquire and of great practical utility.

WRATTEN & WAINWRIGHT,
MANUFACTURERS,
38, GREAT QUEEN STREET, LONDON, W.C.

CULLEY'S PRACTICAL TELEGRAPHY.
In 1 Vol. with 144 Woodcuts and 5 Plates of Machinery and Apparatus. Price 16s. cloth.

A HANDBOOK OF PRACTICAL TELEGRAPHY, by R. S. Culley, Member Inst. C.E. Engineer-in Chief of Telegraphs to the Post-office. (Adopted by the Post-office and by the Department of Telegraphs for India.) A Sixth Edition, thoroughly revised and enlarged.
London: LONGMANS & Co.

GEOLOGY.—Elementary Collections, to illustrate the new edition of Lyell's "Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also single Specimens of Rocks, Minerals, Fossils, and recent Shells. Geological Maps, Hammers, all the recent publications, &c., of J. TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical instruction is given in Geology and Minerology by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W.C.

MESSRS. H. A. HARBOROW & H. SPAGNOLETTI
Electric Telegraph Engineers,
CONTRACTORS AND MANUFACTURERS,
4, Circus Street, Marylebone, W.

Makers of Block Instruments, Single and Double Needle Instruments, Coils for same with Induced Needles. Lines constructed and maintained. Batteries of every description. Electric Bells, Indicators, Thief and Fire Alarms for private houses, banks, hotels, warehouses, &c. &c. Lightning Conductors. All kinds of Electrical Mining Apparatus. H. and H. S. draw attention to their Bells, &c., especially adapted for mines. Models made. Experiments carried out.—4, Circus-street, Marylebone, London, W.

TELEGRAPH CONTRACTORS (Home or Foreign) can be supplied with every description of Cabinet Work, at WM. M. FOXCROFT'S TELEGRAPH CASE MANUFACTORY, 54, COMPTON STREET, CLERKENWELL, E.C. Single and Double Needle Instrument Cases, Disc Cases, Morse Boards, and Bell Cases always in Stock. Teak Cases for Station Clocks made to order. Tenders given.

XYZ RAILWAY GUIDE XYZ

In and out of every Town in Great Britain and the principal Continental Cities, without a Second Reference.

BENNETT & Co., 61, FLEET STREET, E.C.

TRUBNER & Cos. PUBLICATIONS.

THE LATHE AND ITS USES, 4th Edition, 8vo., Cloth 16s.
THE AMATEUR MECHANIC'S WORKSHOP, 4th Edition, 8vo., Cloth 6s.
THE MECHANIC'S FRIEND, Crown 8vo., Cloth 4s. 6s.
AMONGST MACHINES, Imperial 16mo., 7s. 6d.

A Catalogue of Works on Applied Science, post free 2d.

LONDON: TRUBNER & CO., 57 AND 59 LUDGATE HILL.

Fcp. 8vo., cloth, 1s. 6d.

ELECTRO-TELEGRAPHY. By FREDERICK S. BEECHEY, TELEGRAPH Engineer. A Book for Beginners.

Royal 32mo. roan, 6s.

A POCKET-BOOK OF USEFUL FORMULÆ AND MEMORANDA FOR CIVIL and Mechanical Engineers, by Guildford L. Molesworth, Mem. Ins. C. E., Consulting Engineer to the Government of India for State Railways. Eighteenth edition, revised, with considerable additions by the author; together with a valuable contribution on Telegraphs, by R. S. Brough. London: E & F. N. SPON 48, Charing Cross. New York: 446 Broome-street.

THE TELEGRAPHIC JOURNAL and Electrical Review.

CONTENTS, 1877.

JAN. 1st.—Photograph of Sir W. Thomson, with Biographical Sketch. State of the Telegraph System in European Countries. Conversazione of Telegraph Engineers. Notes. Physical Society. City Notes on Anglo-American and Direct U. S. Cable Co. West India and Panama Co. Inventions wanted. Transmission of Observations in Times of Thunderstorms, etc.

JAN. 15.—Telegraphic Progress in 1876. The Arlsey Railway Accident. On the Electric Conductivity of Water. Notes. City Notes on Anglo-American West India and Panama, Western and Brazilian Co.s. Society of Telegraph Engineers. Simultaneous Ignition of Mines, etc.

FEB. 1st.—Prof. Abel's Address. Smee and Bain. Thomson and Jenkin's Auto Curb-sender (Illustrated). Notes. City Notes on Globe Telegraph and Trust Co., Direct Cable Co., and Anglo-American Telegraph Co. Physical Society. Society of Telegraph Engineers. Electrical Science in Foreign Journals, Patents, etc.

FEB. 15.—Telegraph Reform in Germany. The Telephone. On the Propagation of Electricity in Cylindrical Conductors. Comparison of the Batteries used in Telegraphy. Notes. City Notes on The Globe Trust Co. Threatened Action for Libel. Reply thereto and Apologies. Physical Society. Society of Telegraph Engineers. Reviews. Electrical Science in Foreign Journals, etc.

RUPTURES.—By Royal Letters Patent.

WHITE'S MOC-MAIN LEVER TRUSS

Is allowed by upwards of five hundred **Medical Men to be the most effective invention in the curative treatment of HERNIA. The use of a steel spring, so hurtful in its effect, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive Circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, two inches below the hips, being sent to the Manufacturer,**

MR. JOHN WHITE, 228, PICCADILLY, W.

Price of a Single Truss, 16s., 21s., 26s. 6d., 31s. 6d., postage-free. Double Truss, 31s. 6d., 42s., and 52s. 6d., postage-free. An Umbilical Truss, 42s. and 52s. 6d., postage-free.

Post-office Orders to be made payable to JOHN WHITE, Post-office, Piccadilly.

NEW PATENT

ELASTIC STOCKINGS, KNEE-CAPS, &c

For Varicose Veins, and all cases of Weakness and Swelling of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and are drawn on like an ordinary stocking. Price from 4s. 6d., 7s. 6d., 10s., to 16s. each, postage free.

JOHN WHITE, MANUFACTURER, 228, PICCADILLY, LONDON.

ELECTRICAL WIRES KEPT IN STOCK OF HIGHEST CONDUCTIVITY.

J. & W. RICKARD,

Insulated Wire Manufacturers, Derby.

Agent for London: G. E. GALE,
2, GUTTER LANE (one door from Cheapside).

TO TELEGRAPH FIRMS AND RAILway Companies. A Telegraph Engineer, German, 30, been in England, knowing language well, wishes to obtain a situation where his extensive experience of six years' practice could be utilised; knows thoroughly the construction of telegraph apparatus erection, and working of land lines, including Railway Block System, manufacturing and testing cables, etc.; willing to travel; first-class references; apply by letter to S. W., Post-office, Church-street, Woolwich.

THE SCIENCE DEPÔT AND EXCHANGE.—General Scientific and Telegraphic Instruction; The Construction, Purchase, Sale, Exchange, Hire, or Valuation of (full-size and model) Printing, Alphabetic, and Needle Instruments; and all kinds of Electric, Pneumatic, Acoustic, Heat, Optical, Mechanical, Photographic, Chemical, and other Apparatus; Lathes, Tools, Engines, Boilers; Astronomical, Surveying, and Drawing Instruments; and all kinds of Material, Parts, Fittings.—Apply to Dr. A. CAPLATZI, Science Depot, Chenies-st., Tottenham-court Road.—Immense Stock, and variety of second-hand Instruments at half-price.

THE TELEGRAPHIC JOURNAL.
Vol. V.—No. 98.

AMALGAMATION *v.* INDEPENDENCE.

We have often heard an opinion, advanced by such men as Mr. Ford, Sir James Anderson, Mr. Pender, and others, whose claims to be considered as authorities on Telegraph matters nobody can doubt to be well founded, that amalgamation, or arrangements akin to it, formed the safest means of insuring permanent and growing dividends to investors, power and success to the amalgamated Companies, and a practical monopoly of the message-carrying trade.

We have always reverentially listened to utterances falling from the lips of such telegraphic lights, and we have taken these opinions for granted, until we should have time and opportunity to investigate them for ourselves.

We have now taken some considerable trouble to study the question whether the process of amalgamating telegraphic undertakings has or has not been a beneficial one to the shareholders, as well as to the careers of the Companies concerned.

We have taken the three largest English Telegraph Companies—

The Eastern Telegraph Company (Limited),

The Eastern Extension Telegraph Company (Limited), and

The Anglo-American Telegraph Company (Limited),

And, by way of comparison, their respective unamalgamated competitors—the Indo-European Telegraph Company (Limited), and the Direct United States Cable Company (Limited).

To judge from the results of these amalgamations, the products of which were the three first-named Companies, and which took place about four years ago, it appears to us that the result has *not* been beneficial, and we are grieved to say that our confidence in the infallibility of the telegraphic authorities, some of whom we have quoted above, has received a most rude shock.

We have embodied the results of our analysis, in order to render them more graphic to our readers, in the four tables marked respectively A, B, C, and D.

The Eastern Telegraph Company is the product of the amalgamation of—

The Anglo-Mediterranean Telegraph Company,

The Falmouth, Gibraltar and Malta Telegraph Company,

The Marseilles, Algiers, and Malta Telegraph Company, and

The British Indian Submarine Company.

The Eastern Extension Telegraph Company is the product of the amalgamation of—

The British Indian Extension Company,

The China Submarine Company, and

The British Australian Company.

The Anglo-American Telegraph Company is the product of the amalgamation of—

The Anglo-American Telegraph Company,

La Société du Cable Trans-Atlantique Français,

The New York, Newfoundland and London Company.

As a starting point, we have taken for each of the amalgamated Companies the date of their respective amalgamations.

We have taken our figures from the published Balance-Sheets of the various Companies, and we have continued them to as recent a date as either the published statements or information kindly furnished to us by the Companies' officers or gathered from other sources have enabled us to do.

In tables A and B the first columns contain the dates, the next the respective capitals on those dates, the third the traffic receipts on those dates, and the last the percentage which the traffic receipts, when taken yearly, bear to the total capital. As traffic receipts, we have taken the receipts of the respective Companies for the service performed in the transmission of messages over the Companies' own systems, after we have deducted "paid-outs" to Government lines or other Companies for service performed by them in part-transmission of messages, or for rent of lines not owned by the Companies.

The figures thus arrived at have been made the basis of the graphic representations marked C and D.

In these the vertical lines separate the periods of time over which the analysis extends. The horizontal lines indicate the percentages of traffic receipts to capital. The mark "o" indicates the percentage at the period terminating at the date given on the vertical line. These marks (o) are connected by straight lines to show the decreasing or increasing percentage of traffic to capital.

These tables speak for themselves, and teach an obvious lesson. When, four years ago, a strenuous effort was being made to unite the Indo-European with the Eastern Company, Indo-European shares were £12 to £14 in the market, and their percentage of traffic to capital was only 6 per cent. The Eastern Company's percentage was then over 11 per cent.

The amalgamation was not carried out, and shall we say that the Directors of the Indo-European acted not wisely? During the past year the Indo-European percentage has nearly reached 20 per cent., while that of the Eastern does not exceed 9 per cent.!

In the case of the Anglo-American, its percentage has decreased from over 11 per cent. to under 7 per cent.; and that of the Direct has risen from below 4 per cent. to above 13 per cent.!

Nevertheless at this moment Mr. Pender proposes to the Direct a joint-purse arrangement with the Anglo-American. Is it difficult to see what the Direct shareholders' answer must be? Can it possibly be in favour of amalgamation in a mild form—viz., joint-purse agreement? No, no, Mr. Pender. With a policy invariably successful in the past, a man may advise others how to manage their own property; but with a policy which has decreased and not increased the earnings of those whom he guided in former days, he had better try to learn a lesson, rather than insist on teaching one.

The lesson we would wish Mr. Pender and his followers to learn is, that no amount of amalgamating and combining can give a practical monopoly, and thus insure high returns; that the message-sending public will not allow itself to be charged rates which are fixed by monopolists; that progress in everything, and in nothing more than in Telegraphy, is best furthered by competition; that so long as there exist cable-makers, new Companies will spring up to compete with the would-be monopoly companies for traffic; and that the best way to insure proper dividends, and avoid needless competition, is to keep the capital of Cable Companies at as low a figure as their assets are worth, and not to water it.

TABLE A.

Date.			*Indo-European Company.*			*Eastern Company.*			*Eastern Extension Company.*		
			Capital.	*Traffic Receipts.*	*Per cent.*	*Capital.*	*Traffic Receipts.*	*Per cent.*	*Capital.*	*Traffic Receipts.*	*Per cent.*
				FOR 12 M.			FOR 6 M.				
1872	Sept.	30	... ...	... ...	...	£3,397,000	£175,470	10.3	... ...	... ...	...
,,	Dec.	31	£425,000	£25,079	5.9	... ...	... ...	...	... ...	... ...	...
1873	March	31	... ...	... ...	...	£3,532,615	£199,129	11.3	... ...	... ...	...
,,	Sept.	30	... ...	... ...	...	£3,690,339	£177,885	9.6		FOR 12 M.	
,,	Dec.	31	£425,000	£42,897	10.1	... ...	... ...	...	£2,010,600	£222,641	11.1
1874	March	31	... ...	... ...	...	£3,896,865	£200,704	10.3		FOR 6 M.	
,,	June	30	... ...	... ...	...	... ...	... ...	...	£2,007,400	£115,220	11.5
,,	Sept.	30	... ...	... ...	...	£3,896,967	£175,767	9.0	... ...	... ...	...
,,	Dec.	31	£425,000	£67,563	15.9	... ...	... ...	...	£2,005,400	£110,422	11.0
1875	March	31	... ...	... ...	...	£3,897,000	£199,893	10.3	... ...	... ...	...
,,	June	30	... ...	... ...	...	... ...	... ...	...	£2,002,200	£110,278	11.0
,,	Sept.	30	... ...	... ...	...	£3,929,000	£184,645	9.4	... ...	... ...	...
,,	Dec.	31	£425,000	£76,835	18.1	... ...	... ...	...	£2,249,660	£108,643	9.7
1876	March	31	... ...	... ...	...	£4,042,323	£177,650	8.8	... ...	... ...	...
,,	June	30	... ...	... ...	...	... ...	... ...	...	£2,276,000	£98,202	8.6
,,	Sept.	30	... ...	... ...	...	£4,296,366	£185,490	8.6	... ...	... ...	...
,,	Dec.	31	£425,000	£82,000*	19.3	... ...	... ...	...	... ...	... ...	...

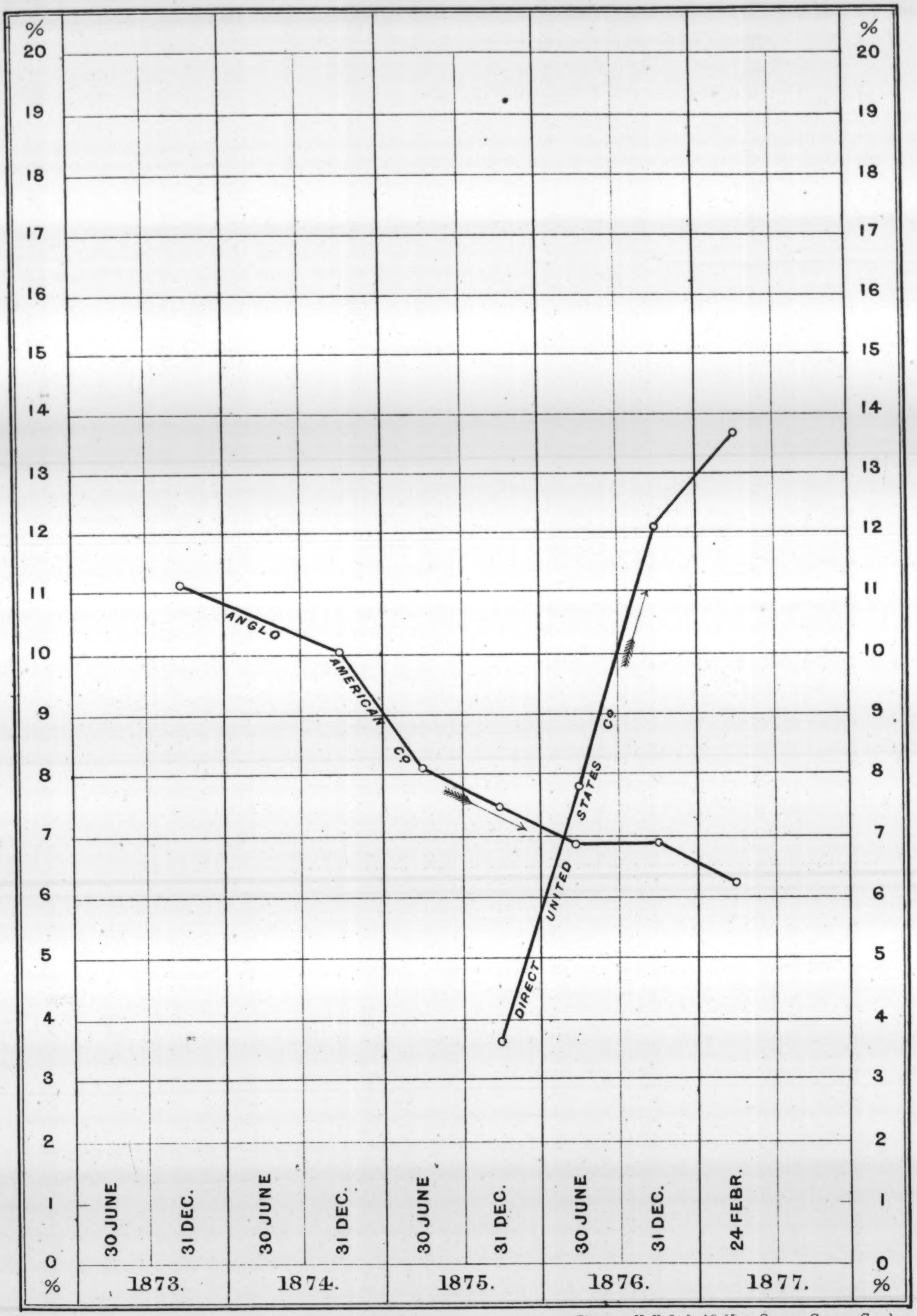
* Estimated.

TABLE B.

Date.			*Anglo-American Company.*			*Direct United States Company.*		
			Capital.	*Traffic Receipts.*	*Per Cent.*	*Capital.*	*Traffic Receipts.*	*Per Cent.*
1873	December	31	£7,003,500	FOR 8 MO. £517,792	11.1	... ...	... ...	...
1874	December	31	£7,000,000	FOR 12 MO. £699,854	10.0	... ...	... ...	...
1875	June	30	£7,000,000	FOR 6 MO. £284,395	8.1			
,,	December	31	£7,000,000	£264,324	7.5	£1,293,013	FOR 3½ MO. £13,578	3.6
1876	June	30	£7,000,000	£241,678	6.9	£1,307,738	FOR 6 MO. £50, 55	7.8
,,	December	31	£7,000,000	£241,467	6.9	£1,307,738	£79, 21	12.1
1877	February	24	£7,000,000	FOR 8 WKS. £66,500	6.3	£1,307,738	FOR 8 WKS. £27,052	13.7

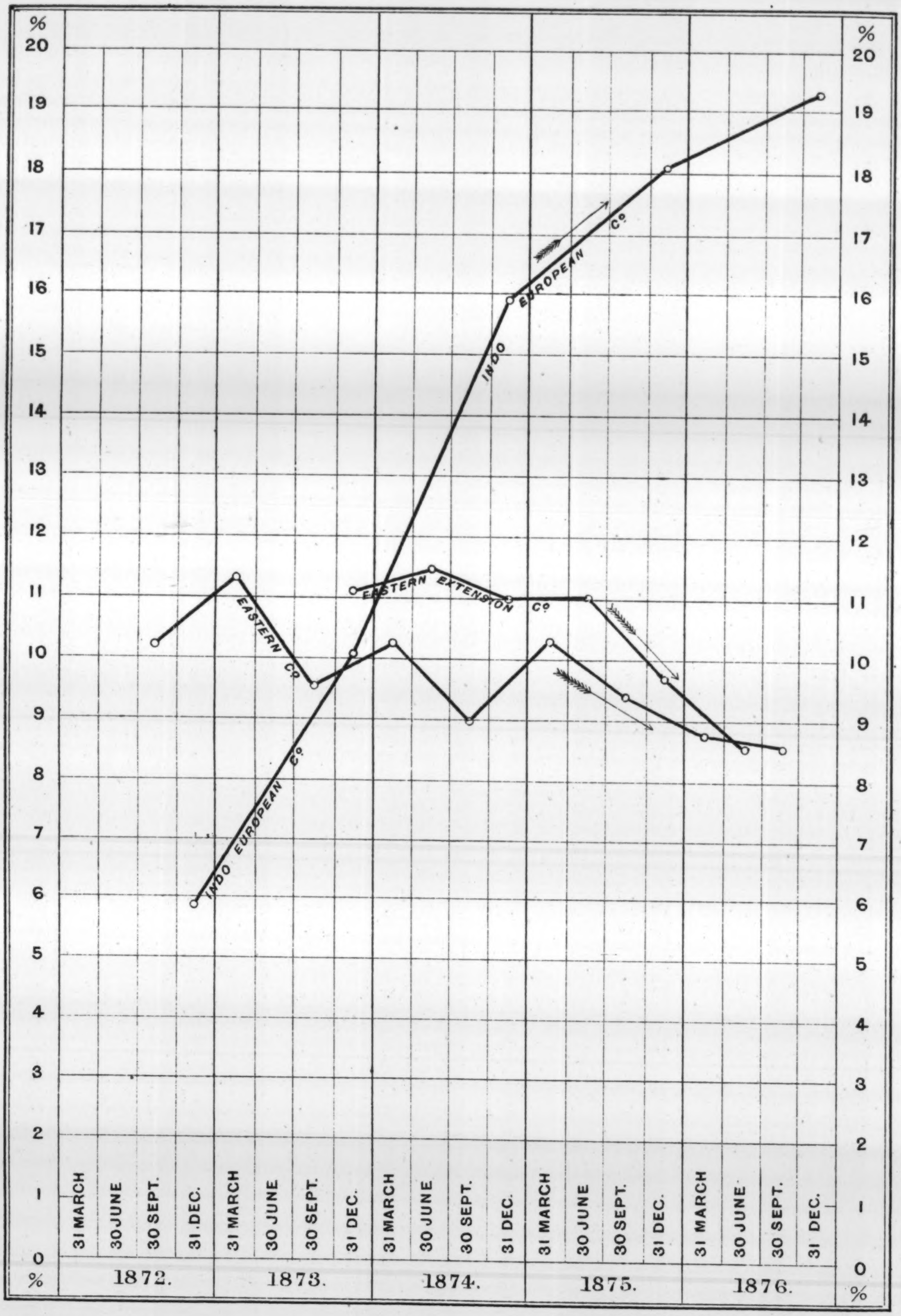
NOTE TO TABLES A AND B.—Traffic receipts taken after deduction of Paid-outs and rent for landlines. The percentages represent the proportions of these receipts (calculated for a period of twelve months) to the then paid-up Capital of the respective Company.

TABLE D.



Thomas Kell, Lith. 40, King Street, Covent Garden.

TABLE C.



Thomas Kell, Lith. 40, King Street, Covent Garden.

REPORT OF THE ROYAL COMMISSION ON RAILWAY ACCIDENTS.

The Commissioners appointed to inquire into the causes of accidents on railways and into the possibility of removing any such causes by further legislation on the 8th of June, 1874, have, at last, mpleted their inquiries, and issued their Report. e Report does not come before the public as the nimous expression of those nominated to the nmission. It bears the signatures of six only ut of nine Commissioners named, and two out of he six afford subsidiary reports on points at hich they are at variance with the decisions arrived at by those acting with them. Lord de la Warr also appends a report, in which he reviews the points considered by the Commission, and in which he explains the grounds on which he declines to sign the Report of the majority. The two absentees are the Duke of Buckingham and Mr. Ayrton. The former, it is known, has been called to India, but no reason is assigned for the absence of Mr. Ayrton. The document does not therefore carry with it all the force it would had it been the unanimous expression of the whole Commission. Still the subject would appear to have been well considered, and the resolutions arrived at to have been well founded.

The Commission is unanimous and decided in s opinion that no legislation is desirable which would impair the responsibility which the law now imposes on Railway Companies; but it is nevertheless of opinion that some measures of a definite and decided character are necessary to afford the public additional safeguards against the preventable dangers of railway travelling. In some instances the general recommendations of the Report would have assumed the form of distinct proposals for legislation, but that it was feared the principle of undivided responsibility of the Railway Companies would thereby have been endangered—a point regarded as of fundamental importance.

Amongst those causes which contribute to railway accidents, the greatest and most frequent is the fallibility of railway servants. It is believed that although this element of danger cannot be eliminated, it may be considerably modified by the general adoption of various improvements. To effect this it is proposed that discretionary powers shall be conferred upon the Board of Trade for the following purposes:—

1. To enforce the extension of stations and sidings, wherever the accommodation provided for the traffic is so inadequate as to endanger safety.
2. To enforce the adoption of the block and interlocking systems on all lines or portions of lines, where the introduction of these improvements is necessary for the safety of the traffic.
3. To restrict the speed of the trains upon any ine or section of line which is in a condition to ender a high rate of speed unsafe.
4. To require Companies to provide their passenger carriages with continuous foot-boards.
5. To impose conditions upon Companies in certain cases in sanctioning the opening of new lines.
6. To require Companies to provide foot-bridges or subways at stations, where the absence of such is proved to be a source of danger.
7. To require a lodge to be maintained at public crossings for foot passengers wherever necessary for safety.

And it is further recommended that all trains shall be provided with sufficient break-power to enable them to be stopped within 500 yards, under all circumstances; that additional facilities shall be afforded to the public for obtaining compensation when trains are late, in order to produce greater punctuality in the conduct of the traffic; that the law relating to intercommunication in trains shall be amended so as to relieve the Board of Trade from the responsibility which now attaches to it of approving the means of communication adopted; and, finally, that there shall be an extension of the civil liability of persons in railway employment for acts of negligence endangering life.

These proposals, if ultimately approved by Parliament, are in each case to be subject to review by a competent tribunal, to whom the Companies may appeal in cases where the findings of the Board of Trade are considered to be extreme, or where special powers are required to give them effect.

The subject will possess electrical interest, chiefly, as regards the decision arrived at with regard to the block system and passenger and guard communication. The former is purely an electrical question, whilst to electrical agency may we look for a definition of the vexed question of passenger and guard communication. It cannot be doubted that, should the recommendations of the Commission have effect, the Board of Trade officers will not miss the opportunity of enforcing a gradual but complete extension of the block system. It is already in use on all busy lines or sections of line—a fact which incontestably speaks for its value and utility, not only in protecting the traffic, and rendering it more safe, but also for the advantages it offers in facilitating it. There are few railways over which the traffic is so light that there is no one point at which trains are so far apart as to render its employment unnecessary; and we may safely regard the question as resolving itself into a complete application of the block on all lines worked by more than one engine. Nor is it likely that any exception will be made in respect of the staff system, for we have seen that accidents occur under it as well as where it is not in use. Moreover, if it were not so, we have the fact that in sanctioning the opening of recent lines the inspecting officers make it a practice to stipulate for the employment of the block. So far, then, a speedy extension of it may with just reason be looked forward to. We note with pleasure that the recommendations under this head extend to the adoption of a proper system of working junctions and protecting station siding and yard-work—points we have always insisted upon.

The question of "passenger and guard communication" is still surrounded with doubt. The Commissioners consider that the "only advance made in the last five years has been to disparage the systems of communication formerly approved, without affording any satisfactory substitute. The consequence is, that the Board of Trade is now unable to sanction any of the systems which have been submitted to it by the Companies." We must confess we are rather at a loss to understand this. We know, as probably everyone else knows, that the "cord" system, which was provisionally sanctioned by the Board of Trade some years since, has proved a failure; but we were under the impression that in the same Report in which Captain Tyler condemned it, he spoke of the electrical communication proving somewhat successful. If this is so, then why should the necessary approval of it be withheld? We have seen it in use on the South-Eastern line now for some years; and we know that that Company's stock is almost entirely fitted with it. We know further that having no confidence in the "cord" system, the South-Eastern Company felt no hesitation, when the Act requiring the establishment of a means of communication became law, in seeking its solution by its means. And we know still further that the London, Brighton, and South Coast Railway is also fitting its stock with an electrical communication, and that all its express trains are already working it. If the Board of Trade declines to sanction it upon grounds of its unreliability, it is clear such should be made known; for, although it is obvious that any such impression can scarcely be tenable, for no Company would go to the expense of such an outlay as its application must incur without having satisfied itself of its worthiness, it is yet very desirable there should be no misapprehension as to the grounds upon which it is thought to be unreliable by the Board of Trade. We have no hesitation in saying that electricity is the agent, and so far as has yet been ascertained, the only reliable and economical agent, calculated to meet the requirements of the question; and if failure has occurred in any of the trials to which it has been subjected, such failure has been due more to the exceptional treatment of the trial than to the agent itself. Let it be fairly established *as a system*, and *systematically used*, and there will be less failure with it than with any other form yet devised. We notice, that the recommendation of the Commissioners extends to the reduction of the 20-mile limit to an 8-mile limit, with an exception as regards all trains which stop at every station. Practically this means the simple abolishment of the 20-mile limit on all large railways, and, excepting omnibus trains, the fitting of all railway passenger stock. The position of the question is now this:—The Act requires the Board of Trade to give its approval of any system adopted. This approval has been accorded in respect of the South-Eastern Railway in favour of the "electrical" system, and in respect of the northern lines in favour of the "cord" system, but only provisionally. The Commissioners now recommend that the Act shall be carried out, but that the duties of the Board of Trade shall cease as regards its required sanction. So that the responsibility of providing an efficient and proper means of communication is to rest with the Company. How we are to learn its efficiency is not evident. It would rather appear that so long as the Company provides *a* communication, no one can complain until in the moment of need it has been found wanting. Then probably some inquiry would be made, and in the course of time the Company would no doubt be advised that its mode of communication was not efficient, and be requested to find another and a better one. If the Company was civil, it would perhaps do so, but in all probability it would maintain that the system it employed was in every way perfect, and decline to spend any more money on the subject. We do not see our way out of this position, and it appears to us that to remove the question entirely from the jurisdiction of the Board of Trade and to give their inspecting officers no voice in the matter, is an injudicious course, and one which will be productive of considerable dissatisfaction. As regards this question, the Commission has certainly done very little to set things in better order. We can only hope that when it comes before Parliament it will receive that consideration it merits, and that in the end we may have something more tangible than is afforded by the present "cord" system.

FULLER'S MERCURY-BICHROMATE BATTERY.

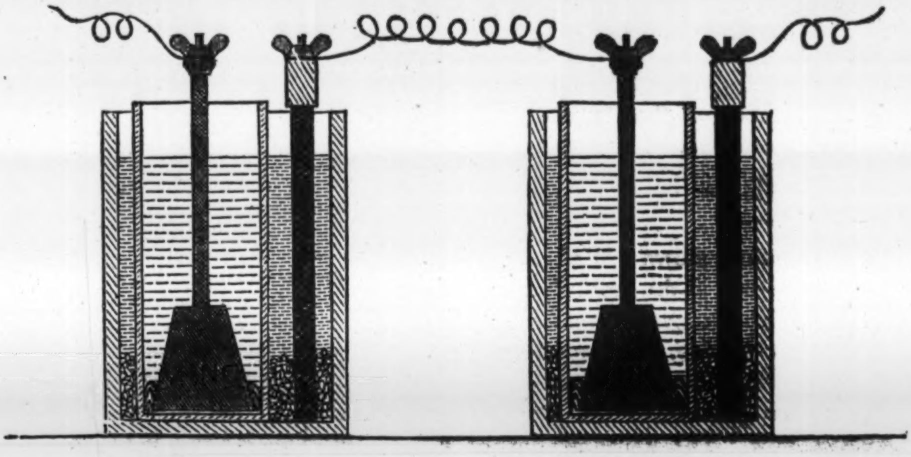
IN the *resumé* of "Telegraphic Progress in 1876," which has already appeared in the pages of the JOURNAL,* mention was made of the new form of Bichromate battery recently introduced by Mr. John Fuller. The introduction, however, of a new battery by one whose experience on the subject extends over so wide a range as Mr. Fuller's, deserves something more than a passing word. So many galvanic combinations of one sort or another are almost daily being brought forward, that we are compelled to pass by the greater number of them unnoticed. It is therefore no small comfort when amongst the crowd we alight upon one whose behaviour thus far does not belie the fair promise which it at first sight held out, and whose employment in the every day work of practical telegraphy seems likely to be attended with success.

The old Bichromate of Potash, Carbon, or Electropoion battery, as it has been indifferently named, was thought by most people to have become all but a matter of history, and few anticipated its re-appearance on the scene of action in active competition with such rivals as the Daniell and the Leclanché. Mr. Sivewright, speaking of it in his paper "On Batteries and their Employment in Telegraphy," read before the Society of Telegraph Engineers in the beginning of 1875, says, "*The amalgamation of the zincs, a point of vital importance in both this and Grove's battery, had constantly to be seen to;*" and further on he adds, "Both (the Bichromate and Grove's) have now had their day, so far as general practical working for telegraphic purposes goes, and will in all probability be speedily numbered amongst the experiences of the past. The wonder really is how, in the face of the other forms of batteries, they could ever have stood their ground so long and so well as they have done." In the discussion which followed consequent upon the reading of this paper, Mr. Higgins, of the Exchange Telegraph Company, stated that "the battery, although the best for their use, was a most inconvenient one."

---

* TELEGRAPHIC JOURNAL, No. 95, p. 14.

Now, Mr. Fuller, by taking up "the point of vital importance," and rendering his zincs, so long as they last, permanently amalgamated, has not only rescued the Bichromate battery from being included amongst the lumber of the past, but has given to it a fresh lease of life, and the prospect of a longer existence than even in its palmiest days it could formerly have dared to hope for. In the accompanying figure two cells are shown. The carbon plate is placed in the outer vessel in a solution of the Bichromate of potash. Three ounces of the crystals of this salt are placed in each cell, in a solution consisting of nine parts of water to one of sulphuric acid. The zinc element, which is of the shape shown in the figure, is placed in a porous tube, to which an ounce of mercury is added, and which is then filled up with water only. The addition of this mercury is the essential feature of the battery, and to it the disappearance of the main objections which were previously to be urged against the old Bichromate form is chiefly due. The zinc plate is in this way kept permanently amalgamated so long as it lasts; the consequence is that not only is the internal resistance of the battery largely diminished, but its constancy—the *sine quâ non* of any galvanic combination for telegraph purposes—is to a great extent insured. The action, after the battery is charged and the elements are connected with each other, commences almost immediately, and reaches a maximum in the course of a few hours.



The maintenance is a very simple matter. On an ordinary working circuit, such, for instance, as a single needle or moderately busy printer, no extra crystals will be required, after the battery is once set up, for a period of six months. So long as the solution remains of an orange colour, none, it is stated, will be required; only when it begins to assume a blue tint need crystals be added to it. The only specific fault which developed itself in the battery during an experience of over eighteen months was the eating through of the rod of the zinc element, under the influence of the acid employed. This danger has been effectually got rid of by covering the rod with some protective covering—wax, india-rubber, or the like. An objection urged against the battery was that even when the cell was not in action, the zinc seemed to be acted upon and gradually to disappear. Such may doubtless be the case, for the mercury has the power of effecting this: but from the resulting amalgam which is thus formed it will be found that an electro-motive force will be produced as powerful as that in the original combination; and the strength of current will be in no way diminished so long as a good connection is ensured between this amalgam and that portion of the metallic zinc which remains.

The electro-motive force of the combination is equal to about two volts, or twice that of the Daniell's cell; the internal resistance, by varying the thickness of the porous vessel and the strength of the solution, may be made to vary from half an ohm up to four ohms, according to the work which the battery is called upon to perform.

In point of cost this battery compares very favourably with those which are at present employed in England. Taking, for instance, the Daniell, and assuming that both are employed on a hard-worked wire, say joined up in closed circuit or on one of the railway block-signal circuits, the statistics of the cost of each will be found to be as follows:—

Daniell.

Prime cost of a ten-cell trough fitted complete	£1	2	4
Sulphate of copper for six months	1	1	8
Complete renewal at the end of six months	0	14	10

Fuller's Mercury-Bichromate.

Prime cost of a three-cell battery (equivalent to a ten-cell Daniell)	£0	15	0
Bichromate of potash and sulphuric acid for six months	0	3	7
New zincs and mercury at the end of six months	0	2	8

Neither the carbon plates nor porous pots are taken into account. No evidence has yet come before us as to how long these are likely to last. The former would appear to be practically indestructible, and no appearance has hitherto been observed of any local action going on with them, nor of the peeling and cracking of the porous partitions which at times prove so troublesome in the Leclanché.

Generally speaking, this Mercury-Bichromate battery will be found far more economical, and, with few exceptions, as reliable as the Daniell. It is well adapted also for medical and experimental purposes, such as the working of induction coils, firing of fuses, heating platinum wire, and the like, combining, as it does, at a much smaller cost, the good qualities of the Grove with the convenience in handling of the Daniell.

Notes.

In his "Life of Thomas Edward," the Banff cobbler and naturalist—one of the most charming works, by the way, which the general reader need care to take up—Mr. Smiles, in describing a thunderstorm which his hero witnessed while crouching beneath a gravestone in Boyndie Churchyard, relates how "The lightning flashed in red and yellowish fiery streams, *each flash leaving behind it a suffocating, sulphurous odour.*" This, we are inclined to think, is what Professor Tyndall would call an unscientific use of the imagination. "*Ne sutor ultra crepidat,*" we found ourselves involuntarily repeating, as we read the passage.

And did not the "shoemaker go a little beyond his last" who, in that "incidental" article on "Duplex Telegraphy" which appeared in the *Times* a short time back, speaking of the much greater difficulty which existed in the way of duplexing submarine cables than land-lines of any length, gave the following as the reason:—"The latter differ from the former by *being more completely insulated;* the submarine cables being surrounded by water which is in contact with the earth, and which brings them into direct relation with it. One effect of this relation is that the passage of the battery current along the wire *produces an induced current around it*, which delays the speed of the battery current," &c. The italics are our own, and comment upon the passage is needless. We also learn, for the first time we confess, that Mr. Varley attempted to overcome the difficulty in the way of duplexing a submarine cable, and failed through his "combination for imitating the capacity of the submarine cable itself, not being sufficiently uniform in its qualities." The article in question, however, doubtless served the purpose for which it was written. It told the readers of the *Times* the most noteworthy telegraphic fact of these latter days, namely, that the Eastern Company had succeeded in duplexing their cables right through from Marseilles to Bombay, and that this result had been attained by the employment of John Muirhead, Jun.'s combined condenser and rheostat for securing a balance.

"Wanderer," from the Raleigh Club, sends to an evening contemporary the following "Mother Shipton's Prophecy," which he says was copied from a work published A.D. 1448, and now in the British Museum.

> "Carriages without horses shall go,
> And accidents fill the world with woe.
> *Around the world thoughts shall fly*
> *In the twinkling of an eye.*
> Water shall yet more wonders do;
> How strange, yet shall be true.
> The world upside down shall be,
> And gold shall be found at the root of a tree.
> Through hills man shall ride,
> And no horse or ass be at his side.
> Under water men shall walk,
> Shall ride, shall sleep, shall talk.
> In the air men shall be seen,
> In white, in black, in green.
> Iron in the water shall float
> As easy as a wooden boat.
> Gold shall be found and shown
> In a land that is not now known.
> Fire and water shall wonders do;
> England shall at last admit a Jew.
> The world to an end shall come
> In eighteen hundred and eighty-one."

The fears which would unbidden start themselves when we read the second couplet were allayed a few days later by "Investigator," who, writing from the St. James's Club, stated that he was unable to trace that couplet prior to the latest edition of Mother Shipton's prophecy, which was printed in 1871. The "Wonder of the Age," which "Under the Special Patronage of Her Majesty," was as far back as 1845, being exhibited in operation between Paddington and Slough, had probably been seen by the editor before the couplet in question was penned. Could Dr. Cumming have had anything to do with it?

Mr. John Stephen, of Dean Bank, Edinburgh, has addressed a couple of lengthy letters to *The Northern Ensign*, in which he advocates the cause of his friend, the late Mr. Alexander Bain, with an eloquence and warmth of feeling that do more credit to his heart than to his head. If the maxim of "*nil nisi bonum de mortius*" is to be so strictly adhered to as in this case, it would be equally advisable to adopt a similar policy with reference to the living. It can serve no earthly purpose to assert that "Mr. Scudamore granted to hundreds of sneaks and fools what he denied to Bain," because it is simply untrue, nor do we see what advantage is likely to accrue from such statements as the following:—"Great journals paid 1s. per printed inch or £1 16s. per yard for falsehood, fraud, and wilful imposition, as they subsequently found, the meaning of which was that man's chief end was to glorify Scudamore, who said that 'oxen make turnips remarkably cheerful' (the other way about, was it not, Mr. Stephen ?) in a mnemonic device for learning the Morse alphabet, the only original thing which he had invented, for most original things ascribed to him in the press had been given to him by *myself* and others." It is the "self" running very conspicuously through both letters which, we are inclined to think, furnishes one of the main reasons for their ever having been written at all. Their ostensible purpose is to initiate a movement for raising a monument of some sort or another in memory of Bain, and while *one* word is urged in favour of this laudable object, at least *two* are put forward in order to show that something of the same sort should be done, when the proper time comes, to mark the British nation's appreciation of the hitherto unrecognised labours of "John Stephen, Electrician."

The Society of Telegraph Engineers have still further strengthened their list of Honorary Secretaries by adding to it the well-known name of Dr. Werner Siemens, of Berlin, and that of Don José Aparicio, of Madrid, as Honorary Secretaries for Germany and Spain respectively.

Among the forthcoming works announced by Messrs. Macmillan and Co. is one "On the Applications of Electricity to Railway Purposes," by Mr. W. Langdon, of the Postal Telegraph Department. As the field is a wholly untried one, there being so far as we are aware nothing in existence on the subject, the book will doubtless have a large and ready circulation. Mr. Langdon's thorough mastery of the subject is a sufficient guarantee for the character of the work.

Mr. Robert Sabine having signified his desire to withdraw from the Council of the Society of Telegraph Engineers for the current year, advantage has been taken of the presence in England of Mr. Schwendler, the Electrician to the Government Telegraph Department of India, and the Council have appointed him the position vacated by Mr. Sabine. This step is sure to command the approbation of every Member of the Society, being a recognition not only of the eminent services rendered to telegraphy by Mr. Schwendler, but also of the claims which the Indian members—no unimportant body in themselves—have to being represented at the Council Board, more especially when so favourable an opportunity as this offers itself. Mr. Schwendler is a Member of Council of the Asiatic Society.

Experiments have recently been carried out at Antwerp with a view to lighting up the harbour by means of electricity. They are stated to have been thus far attended with success.

City Notes.

Old Broad-street, 28th February, 1877.

We have up to the moment of going to press received no further communication from Messrs. Bircham and Co.

The controversy still raging between the Globe Company and the Direct United States Cable Company has during the past week been further enlivened by the appearance on the scene of the Anglo-American Telegraph Company. From tomorrow the rates for messages between the United Kingdom and New York, Canada, &c., are to be reduced at the instance of that Company from three shillings per word to one shilling per word.

It was anticipated that the Anglo-American Telegraph Company would hold their hands until the Globe Company's attempt to lick the two Atlantic Cable Companies into loving each other had either succeeded or failed. The Directors of the Anglo Company, however, can evidently no longer restrain their feelings, and they must needs give another proof of their admiration and affection for their younger coadjutor in the field of Atlantic Telegraphy.

The Anglo Company has done much in the past for the benefit of the Direct. In May, 1875, they lowered their tariff to two shillings a word, and continued at this rate until the Direct Cable was opened for traffic, thus providing at their own expense their so-called rival with valuable statistics and experience as to the results of a two-shilling rate. It must be admitted that this was, to say the least, a noble and disinterested act.

When the Direct opened, the tariff was lowered to one shilling, it being, no doubt, thought advisable to collect also some facts regarding the working of this rate. The Direct Cable then broke, and serious apprehensions were entertained by its shareholders that this untoward accident would damage the popularity of the young Company. Yet here again their true friend, though apparent enemy, came to the rescue. The Anglo Company, with a delicate discrimination of what would render itself most unpopular with senders, and thus by comparison benefit the Direct, raised its rate to four shillings per word. When the Direct Cable was repaired, a three-shilling tariff was adopted, and proved very remunerative to the Direct, which began to take a constantly increasing portion of the traffic. When the Direct, in November last, had obtained about 26 per cent. of the gross traffic of the Atlantic (which really was not bad, as its capital is only 15 per cent. of the gross capital currently supposed to have been invested in Atlantic Telegraphs) the tender solicitude for the younger Company contrived and carried into effect yet another act of self-abnegation, than which nothing more effective could well be devised.

Mr. Pender, whose time was already so much occupied by the many and important duties devolving upon him, came forward, and his action displayed that singular tact in feeling the public pulse which has been all along so characteristic of him, and which only a career in the legislation of his country could develop in the brain of any individual no matter how astute by nature.

He no doubt felt that it would be difficult for the Direct to obtain in the ordinary course of events one-third of the Atlantic traffic, a percentage which that spoiled child was hankering after. He gave it, therefore, an opportunity of protesting publicly and emphatically that it would never ally itself to "that old Anglo": that it would *not* put up rates, that it would *not* renounce giving silly facilities to the customers, and lo! behold, the message-sending public, always ready to support self-willed obstinacy and ingratitude against an old friend, rushed in—and now the Direct has its third of the traffic.

Having thus guided the youthful steps of the Direct and assisted its healthy growth until that Company has nearly paid off all the debt incurred for the repair of those early mysterious breakages, until it has obtained a good firm hold upon one-third of the message-sending communities on both sides of the Atlantic, and until it has put by at its bankers something like £30,000 in cash, the Anglo-American Company now proposes a trial of strength which a less considerate opponent might have tried and fought out at the beginning. The very circular of the Anglo-American Company, announcing the reduction of the tariff, shows the total absence of any animosity on their part, and it contains such playful expressions as would soften the heart of any child whose heart, unlike that of the Direct Company, had not been rendered obdurate and unfeeling as flint by a succession of past favours. We regret that there does not seem to be the slightest tendency on the part of that Company to meet their elders and betters as they ought to do. They seem simply bent on earning as much as they can for their shareholders—and that is mean—they won't give up rebates which they are legally empowered to allow, and which the Anglo cannot give under the Telegraph Acts—and that is not handsome. They maintain that with a capital of 15 per cent., and earnings of 33 per cent., they can better endure a competitive struggle than their older friends, and they totally forget whom they have to thank for their fine traffic.

They laugh at the idea of a prolonged one shilling rate, and seem rather inclined to continue the experiments already made with different rates, and hint that they should like to see the result of a 6d. rate. There are, however, limits to friendship, and it is questionable whether their old friend will go so far as to oblige them in trying this.

In the meantime, we wish to warn the Direct not to be too confident. There may be shareholders in that Company who do not approve of ingratitude, and who will wait until "Directs" are temporarily low in the market, and then go and sell them to Mr. Pender, so that he may after all conquer the prudish Company, and install himself comfortably in its presidential chair.

Seriously speaking, as far as the public is concerned, the whole movement is sincerely to be deprecated; the low rates are not likely to last, and therefore no gain will accrue to senders, whilst this knocking up and down of the value of telegraph securities in this fashion can only tend to discourage further telegraphic enterprise.

And so Hooper's is at last to be wound up. The result is not to be wondered at, after the experience of later days, although everyone who has at all studied the subject will, we think, be inclined to agree with us that "some one has blundered," and that too egregiously. That a Company which has executed some of the largest submarine contracts on the face of the globe, at a time when competition was of the most limited nature, should now be passing through the ordeal of the Bankruptcy Court, whilst the shares of its chief rival are at a high premium, is one of those things which, to say the least, are by no means easy to understand. From a professional point of view, Hooper's core cannot be too highly spoken of; and the list of testimonials given in its favour by all the leading electricians, from Sir William Thomson downwards, forms one of the strongest recommendations that could possibly be advanced in favour of any article. Its high insulating qualities and low "inductive capacity," by reason of which the carrying power of cables constructed from it is very largely increased, are admitted on all sides; the only thing that has been urged against it is, that the core is not reliable throughout, but that while, as a rule, it tests and lasts well, specimens are from time to time brought up showing the most marked deterioration, and giving rise to very serious faults. Yet surely such difficulties as these are not insurmountable. Rigidly careful manufacture, combined with a really efficient staff of mechanical inspectors and electricians qualified to do their work at the factory, should go a long way to prevent indifferent material from going to the sheathing works.

The Company again, it has been urged, was unfortunate in the laying of some of its cables. No doubt it was. But was it a misfortune or a fault? May not the breaking of the cables, or their bad working before the Company was relieved of the responsibility, be fairly attributed, in some cases at least, to the hurry with which the work was done? Were accurate preliminary surveys executed in every instance, and soundings taken to ascertain the nature of the bottom so that the apportioning of the different types of cable to the various sections might be properly carried out. Was the selection of good landing-places seen to in every case? If all this was done, then we "give it up," and confess ourselves unable to understand the present position of Hooper's Company.

The Directors of the Western and Brazilian Company have, as we suggested they ought to seriously think of doing,* "duly confirmed some proposals" with reference to their undertaking. They are making frantic efforts to issue *Five Per Cent. Third* Mortgage Debentures, at the price of £80. It is hardly fair to strike a man when he is down, but, considering that there are no profits to meet these Debentures while the *Six Per Cent. First* Mortgage Debentures of the Company may be had any day for £84, we are inclined to adopt the opinion expressed by the "sworn broker" of Tokenhouse Yard, that "this is a species of insanity worthy of the attention of the Commissioners in Lunacy."

Proceedings of Societies.

THE ROYAL SOCIETY.

"*On Stratified Discharges.—III. On a Rapid Contact-Breaker, and the Phenomena of the Flow.*" By WILLIAM SPOTTISWOODE, M.A., F.R.S. Received January 9, 1877.

IN a paper published in the Proceedings of the Royal Society, vol. xxiii. p. 455, I have described a form of contact-breaker designed for great rapidity and steadiness of action. It consisted of a steel rod which vibrated under the action of an electromagnet. As regards sharpness of break and steadiness of definition in the striæ, this instrument left little or nothing to be desired. But, as explained in the paper above quoted, an alteration in the current not only affected the steadiness directly but also reacted on the break itself. The effects due to an alteration of the current alone thereby became masked, and the study of the laws relating to such changes was rendered more difficult, or altogether impracticable. In order to obviate this inconvenience I devised another form of contact-breaker, in which the vibrating rod and electromagnet were replaced by an arrangement purely mechanical in its action, and therefore entirely under control.

This instrument consists essentially of a wheel platinized at the edge, on which a platinum spring rests. In the circumference of the wheel a number (40 in the first instance) of slots were cut, and filled with ebonite plugs so as to interrupt the current. The breadth of the slots was about ·04 inch, and that of the teeth about ·5 inch. The wheel was connected with suitable driving gear, so as to give from 250 to 2,000 currents from the coil in each direction per second. A 4-inch coil was found sufficient to produce the effects; but the 18-inch coil by Apps, mentioned in former communications, was preferable. With the wheel, as with the electromagnetic break, a very slight strength of current was required; but, on the other hand, high tension in the primary was found necessary. In many of the experiments, accordingly, from 10 to 20 of the smallest Leclanché cells usually made were employed with the small, and from 20 to 50 with the large coil. But these were afterwards replaced by a double fluid battery suggested by my assistant, Mr. P. Ward, and described at the end of this communication.

---

* City Notes, TELEGRAPHIC JOURNAL, No. 95, 15th January, 1877.

For some time the experiments were conducted with the platinum spring resting on the wheel; and the effects were varied by altering either the pressure of the spring or the velocity of the wheel; but the gradual abrasion of the platinum through friction proved to be a fruitful source of irregular results. This irregularity of action, at all times difficult to compensate, and sometimes insuperable, was fortunately removed by a simple although delicate adjustment. It was, in fact, found that actual metallic contact between the spring and wheel was not necessary, provided that a layer or cushion of conducting material were interposed. Such a layer was formed by a thin film of liquid drawn out by a thread leading from a reservoir and resting on the wheel. Various fluids were tried, but the simplest, and on the whole the best, proved to be dilute sulphuric acid, in the proportion of 1 drop of acid to 6 drachms of water. Generally speaking, the better conductor the fluid is, the better are the results obtained; but owing to the insulating slots being very narrow in this instance, a comparatively weak mixture of acid and water was necessary. In one wheel, where the insulating slots are ¼ in. wide, the mixture 36 times as strong may as advantageously be used. The spring, which under these circumstances became unnecessary, was replaced by a point, the adjustment of whose distance from the wheel was simpler and more accurate. This arrangement gave excellent results, even when the number of currents per second was reduced in some cases to 250; added to which the unpleasant and disturbing noise of the friction was entirely avoided.

Wheels having different numbers of teeth were also constructed; and what was perhaps of more importance, having teeth of different breadths, so as to give with the same velocity of rotation contacts of different duration. The breadth of the ebonite plugs, or length of interruption of the current, was immaterial, so long as the current was efficiently broken. It did not appear, however, that with the same tube more could be obtained with wheels having different numbers of teeth, than with the same wheels at different speeds. But it was found that for different tubes different wheels occasionally gave better results.

With the contact-breaker here described effects similar to those produced by the rapidly vibrating break were obtained. The striæ were formed in a regular manner, and advanced or receded, or remained at rest, in a column usually unbroken so long as the velocity of the wheel was maintained without change; and even in the longer tubes, where the striæ, of the double discharge, advanced or receded towards both ends at the same time, and sometimes appeared compressed and at others dilated, the phenomena always maintained their characteristic features.

The condition of the striæ here described, whether flowing or stationary, may be comprised under the general term "steady;" and when there is no motion in either direction, they may be specifically denominated as "stationary."

Two questions here presented themselves:—First, what are the conditions necessary for the production of steady striæ? Secondly, what are the conditions and circumstances of the advance and retreat—in other words, of the flow—of steady striæ?

With a view of ascertaining the nature of the distinction between the ordinary and the steady striæ, careful observations were made with the revolving mirror. It having been noticed that when the wheel-break moved slowly ordinary or irregular striæ were produced, and that when it moved rapidly steady striæ resulted, it seemed probable that the latter effect might be due to the short time of contact, and to the consequent absence of many of the features described in Part II. of these researches. This is in fact identical with the suggestion there made, that the fluttering appearance was due to the unequal duration of the striæ themselves, and to the irregular positions of the points at which they were renewed at successive discharges of the coil. And such, in fact, proved to be the case; for as the speed of the wheel was increased the duration of the discharges diminished; the image as seen in the mirror became narrower and simpler in its configuration, until when the steady effect was produced each discharge showed only a single column of striæ of a width proportional to the apparent width of the slit. The proper motion, implied by the inclination of the individual striæ to the vertical, was still perceptible, and was directed as usual towards the negative pole.

From a comparison of the number of striæ as seen by the eye with those seen in the revolving mirror, it was found that the striæ so formed were of the kind called "simple" in former communications. And the phenomena of the flow may therefore be considered to be due to the different positions taken up by the striæ in successive discharges. If in each discharge the striæ occupy positions in advance of those occupied in a previous discharge, the column will appear to advance; if the reverse be the case, they will appear to recede. If the positions remain unchanged, the column will appear stationary.

The following consequence of this explanation of the flow will readily occur to the reader, viz. that the rapidity of the flow will increase with the extent of advance made by the striæ in each successive discharge, until that advance amounts to half the distance between two contiguous striæ. Before this is attained the flow will have become too rapid to be followed by the unassisted eye, and can only be observed by the aid of the mirror. When this rate of advance has been exceeded, the flow will appear to be reversed. If the rate of advance still continues to increase, the rapidity in the reverse direction will appear to decrease until the advance amounts to the entire distance between two contiguous striæ, when it will apparently be reduced to zero; the striæ will then again appear stationary. Experiments appear to confirm this view of the case.

Experiments were next instituted with a view of ascertaining the connection between the flow and resistance. Starting from a condition of current and break for which the striæ were stationary, it was found that an increase of resistance, introduced generally in the primary circuit, produced a forward flow, *i.e.* from the positive towards the negative terminal, while under similar circumstances a decrease of resistance produced a backward flow. Furthermore, if after producing a forward flow the resistance be continually increased, the flow, after increasing in rapidity so as to become indistinguishable by the unassisted eye, gradually appears to become slower, and ultimately to reverse itself, in accordance with the law suggested above.

Another form of contact-breaker was also occasionally used. The principle upon which it was based was the sudden disruption of a thin film of conducting liquid by a discharge between the electrodes of a circuit. The mode of effecting this was to make one electrode terminate in a platinum plate fixed in a horizontal position, and supplied with a uniform film of dilute sulphuric acid; the other in a platinum point, the distance of which from the plate is capable of delicate adjustment by means of a screw. Electro-motive force required for this break is not less than that of 5 cells of Grove.

As soon as the current passes, the fluid between the plate and point will be decomposed, and electrical continuity broken. This done, the fluid flows back again, and continuity is restored. By a proper adjustment of the supply of fluid, and of the distance of the electrodes (the latter varying from ·05 inch to ·001 inch), the number of disruptions may be made to attain 1000 per second.

The currents delivered by this form of break are exceedingly uniform, and the effects produced are quite equal in delicacy to those produced by the electromagnetic or by the wheel-break.

The elements used in the battery to which allusion was made in the early part of this paper are zinc and carbon. The zinc is immersed in dilute sulphuric acid in the proportions of 1 volume of acid to 7 of water; and the carbon in a saturated solution of bichromate of potash with 1 volume of sulphuric acid to 7 of the solution. The carbon and bichromate solution are held in a porous cell.

The absence of nitric acid permits this battery to be used in a room; while the fact that the zinc is attacked only when the circuit is complete, renders it unnecessary to lift the plates out of the fluid when not in use, as in the bichromate battery. The only limit to the time during which this battery may be left untouched, appears to be the period when the bichromate salt finds its way into the outer cell, so as to attack the zinc independently of electrical action. But this does not take place to an extent materially to affect the action for some months.

THE SOCIETY OF TELEGRAPH ENGINEERS

AT the Ordinary General Meeting of the Society held on the evening of Wednesday, the 24th ult., the Paper read was on "Shunts and their Applications to Electrometric and Telegraphic Purposes," by Mr. W. H. Preece, one of the Vice-Presidents of the Society. Mr. Preece departed from the usual custom of reading the Paper as it had been written, and by delivering, so to speak, a lecture on the subject, he transformed, what from its title seemed to be anything but an inviting theme, into one of the most interesting that have ever been delivered before the Society. The lecture was profusely illustrated by well-executed diagrams, and the experiments were exhibited by means of Mr. Latimer Clark's oxy-hydrogen galvanometer specially designed for lecture purposes. This beautiful instrument was, it will be remembered, exhibited at the Conversazione held in December at Willis's Rooms, and nothing could be more admirably adapted for the purpose for which it was intended. It is, we believe, the first apparatus in which the lime-light has been employed in connection with this branch of Science. We subjoin a *resumé* of Mr. Preece's interesting Paper.

Shunts.

When a current passes by more than one path, that specially intended for its passage is termed the *main circuit*, while the rest are termed *derived circuits*.

The effect of introducing derived circuits is to diminish the strength of the current flowing in the main circuit, and when a single derived circuit is applied for this purpose, it receives the technical name of a "*shunt*."

The law of Shunts is as follows:—The strength of current in any branch of a system of derived circuits, or "multiple arc," as it is termed, varies inversely as the resistance of that branch. Hence by varying the resistance of the shunt we vary the strength of current flowing through the main circuit.

The resistance of any multiple arc is thus found. Let R be the resistance of the entire arc and r, r_1, r_2, &c., that of each branch respectively. Then since conductivity is the reciprocal of resistance, we may express our problem by the equation—

$$\frac{1}{R} = \frac{1}{r} + \frac{1}{r_1} + \ldots\ldots\ldots\ldots \frac{1}{r_n}$$

and in the case of a single main and derived circuit, or "duplicate arc", the equation becomes:—

$$\frac{1}{R} = \frac{1}{r} + \frac{1}{r_1}$$

$$\therefore \frac{1}{R} = \frac{r + r_1}{r r_1}$$

$$\therefore R = \frac{r r_1}{r + r_1}$$

That is to say, that the joint resistance of a duplicate arc is equal to the product of the resistances of its branches, divided by their sum.

But by far the most important application of shunts—to electro-metric purposes—would be rendered futile were it not that the resistance of the shunt bears a mathematical relation to the current passing in the main circuit, and that by knowing the one the other can be calculated. Thus, in the case of a galvanometer with a variable shunt interposed between its terminals, by observing the deflection of the needle when the shunt is in circuit, we can determine what the deflection would have been without the shunt, by multiplying the reading by a variable factor termed the "multiplying power" of the shunt. This factor is in mathematical language the expression $\frac{G + S}{S}$ where G and S are the resistances of the galvanometer and shunt respectively.

Another fact worthy of notice in connection with this portion of the subject is that by means of a variable shunt the same deflection of the needle of a galvanometer may be reproduced by currents widely differing in strength, and hence all errors due to inequalities in the value of an uncalibrated scale are entirely avoided.

Electro-Magnetic Induction.

Any portion of space subject to magnetism was termed by Faraday a "magnetic field"; that great discoverer also pointed out in 1851 how the direction and intensity of such a field might be indicated, by conceiving the existence of lines of force similar to those traced by iron filings—when allowed to take up any position—in the presence of a magnet. He showed how in like manner the direction of the force at any point would coincide with the direction of these imaginary lines, and that their number in a given area would be proportional to the intensity of the force at that spot.

When a current is commencing to flow through a wire, a magnetic field is projected into the space immediately surrounding that wire; and since we must suppose that its projection is progressive, we must also suppose that at the cessation of the current the field is contracted by progressive stages, although in a period of time too minute to be appreciable. The equipotential lines in this case would form circles, having the wire for their centre and in planes at right angles to it, while the intensity of the field depends upon the strength of the current traversing the wire.

Conversely, when either a magnetic field is projected through a wire, or a wire passed through a magnetic field, an electro-motive force is generated in that wire, whose amount depends upon the intensity of the field with which it comes into contact. Thus if two wires be placed near each other without touching, and a current be passed through the one, a momentary current will flow in the opposite direction through the other provided its circuit be closed. This secondary current is due to the projection of the lines of force through the second wire from the first wire at the moment the current commenced. But when the field becomes stationary no current is formed in the secondary circuit, for the conditions under which such currents exist are, that lines of force be cut by a conductor, either by their own motion or that of the latter. If, while no current is flowing in the secondary circuit, the wires be caused to approach or recede from each other, then currents are again generated in that circuit whose strength and duration depend respectively on the velocity and time with which these lines of force are cut by the secondary wire. For instance, if we either separate them or allow them to approach each other rapidly, and only for a short distance, the induced currents will be comparatively strong and of short duration, and the reverse under opposite conditions. Finally, if while all remains at rest the current in the primary circuit—which hitherto we have supposed to be flowing—be suddenly stopped, then a second momentary current flows in the secondary circuit of equal or nearly equal strength but opposite in direction to that formed at the commencement of the current in the secondary circuit. Its presence is due to the contraction of the field through the secondary wire.

Having made a brief preliminary examination of induced currents and their causes, we are now in a position to study the induced currents in electro-magnets, or "extra" currents, as they are termed. Let us take, for example, an ordinary coil of silk-covered copper wire wound on a bobbin, as usually employed in telegraphic apparatus. If a current from a battery be passed through the coil, and the circuit be suddenly broken at some point, a minute spark will be observed at that point, provided the wire of the coil be of sufficient length. To what is this spark due? In order to answer this question, the coil should be short-circuited or entirely cut out of circuit, when on repeating the operation no spark will be perceived. The spark must therefore be due to something in the coil-wire. If now a core of soft iron be inserted into the centre of the bobbin, the size and brilliancy of the spark will be greatly augmented. The phenomenon is, in fact, the result of the *induction of the current on itself*.

Let us suppose a current entering the coil-wire—say the top layer—then a magnetic field is immediately projected through those layers immediately beneath it. As has already been shown, a current will immediately be formed in these layers flowing in the opposite direction to the battery current through the coil, thereby retarding its progress. After the first effect all remains quiescent, the battery current continuing its flow uninterfered with; but immediately it ceases, the field surrounding the wire immediately contracts, producing a current in the same direction as the battery current, and so prolonging its effects. Hence the spark. The effect of the soft iron core in the centre of the bobbin is simply to intensify the field, and consequently the effects.

These currents are met with when cable core is coiled, as in a tank, especially when sheathed with iron wires. They then constitute what is termed "false discharge." Theoretically these currents are formed in straight wires, but to such a small amount as to be inappreciable; and even in theory any disturbances created in such a wire could be traced rather to Static than to Dynamic Induction. Distinct evidences of disturbance due to the latter cause are, however, found in telegraph wires, due to their proximity to the earth. They can be entirely eliminated in rheostats, &c., by double winding—*i.e.*, winding half the wire round a bobbin in one direction and half in the other. Any currents set up are therefore opposed and neutralise each other; but it is impossible to have recourse to such an expedient in electro-magnets, inasmuch as for the same reason we can obtain no magnetic effect.

Experimental Investigation.

An extended series of experiments was undertaken by the author of the Paper to ascertain the conditions necessary to obtain the maximum and minimum effects in electro-magnets. For this purpose a Stroh's relay was so arranged, that in its normal condition it allowed a permanent current to traverse the coil or coils of the electro-magnet under examination; but that immediately a key was depressed, a second battery current traversed the coils of the relay, thereby throwing the lever over against the opposite limiting stop, which action at once broke the circuit of the original current, and placed the magnet in direct circuit with a Thomson's galvanometer, so that any extra currents would be observed upon the latter instrument. The following were the results so obtained—

Regarding the current from a single bobbin and core as the unit, two bobbins and two cores (separate) connected in series gave a current of..	17
The two placed end to end so as to form one long core, surrounded by two bobbins connected in series, gave a current of	184
The two cores being connected at the base by a bed or plate of iron, so as to resemble a horseshoe magnet, the connections remaining the same, gave a current of	304
When connected at the base by a cross-piece, and at the extremities by an armature, the connections as above, gave a current of	2238

No increase of the length or size of the armature showed any visible variation from the last results.

The general result may be expressed as follows:—

The nearer the form of the core approaches to that of a ring or closed curve of iron, and the greater the surface of iron surrounded to a given thickness with wire, the greater the strength of the extra current.

If in the last-mentioned experiment the mechanical arrangements remained the same, but the coils were connected "for quantity," the result fell as low as 502. The following were the results obtained with the different relays in general use:—

Siemens'..........................	1688
Stroh's ordinary	1621
Stroh's polarised	1500
Theiler's No. 1	279
Theiler's No. 2, the base piece having been removed......................	26

Static and Dynamic Induction.

The effect of Static Induction in the case of Telegraph Lines is to delay the appearance of a current, and to prolong its duration. Time is required for the charge to dissipate itself, and reduction of the speed of working is the result. We have already shown that Dynamic Induction tends to produce similar effects. So that if the one can be made to counteract the influence of the other, the result of placing electro-magnets in a telegraph line will be a gain instead of a loss in speed.

When an electro-magnet situated on a line of telegraph is shunted by a rheostat or "*simple shunt*," that rheostat tends to become the path by which the extra currents are discharged, and so prolonged is the magnetisation, that if the circuit be closed and opened with any degree of rapidity, the armature sticks or remains permanently attracted—a principle which has been employed by Mr. F. Higgins in double current translation. This retardation is at its maximum when the resistance of the shunt equals that of the electro-magnet. But should the shunt be a second electro-magnet, or, in other words, an "*electro-magnetic shunt*," then the extra current formed in it opposes that formed in the electro-magnet, and both send a current back into the line. The current from the shunt, however, may be so exalted as to neutralise and even overcome that formed in the electro-magnet itself. So that by a properly arranged electro-magnetic shunt, the magnetic retardation in the electro-magnet itself may be reduced to a minimum, while a current is sent back into the line immediately after each signal, thus tending to increase the speed at which that line can be worked.

Space prevents our taking even a brief glance at the numerous and varied uses of Shunts, both to electrometric and telegraphic purposes, save to mention the fact that so important has become their assistance, that no one who has ever given the matter his full attention can ignore the benefits which accrue from their employment. No delicate tests can be made without their aid, and of such growing importance is the part likely to be played by them in the field of practical telegraphy, that it is well-nigh impossible to over-estimate the benefits which may be derived from their employment.

At the close of the lecture, which, although extending over an hour and a half, had been listened to most attentively by a crowded meeting, a hearty vote of thanks was, on the motion of the President, unanimously accorded to Mr. Preece.

The following candidates were balloted for, and declared duly elected:—As Foreign Members: Mr. George T. Helland, Mr. Frederick von der Pforden, Mr. Frederick John Rentsch. As Members: Mr. Richard Anderson, Mr. Hubert Blanchford, Lieut.-Colonel William Crossman, Mr. W. T. Newitt. As Associates: Mr. Robert William Aldis, Lieut. A. H. Bagnold, Mr. S. S. Bailey, Mr. Walter Betts, Corporal A. Botham, Mr. C. M. P. S. Colmache, Mr. J. H. Crilly, Mr. Charles Cuttriss, Mr. W. Dieselhorst, Mr. W. Dickinson, Major A. H. Durnford, Mr. Samuel A. Earle, Mr. Thomas Forster, Mr. J. Games, Mr. Alfred Graham, Mr. H. S. von Graney, Mr. G. A. Green, Mr. T. T. Hockley, Mr. Thomas Isley, Mr. J. W. James, Mr. James R. Macdonald, Lieut. J. C. McGregor, Mr. R. J. Needham, Mr. C. Newitt, Mr. C. J. Page, Mr. F. Perry, Mr. Edward Rau, Mr. Walter C. Ross, Mr. L. J. Rosse, Mr. R. L. Saunders, Mr. J. Scotland, Mr. J. E. Talbot, Mr. Frederick Squires, Mr. C. Trippe, Mr. J. K. Webster, Mr. H. R. P. Ward, Mr. E. Weedon, Lieutenant Mortimer D. Whitmore, Mr. A. G. Williams, Mr. W. Woodcock. As Students: Mr. G. L. Davies, Mr. Robert Lewis. In addition to these thirty more were suspended for ballot on the 14th of March.

The meeting then adjourned.

The chair will be taken at eight o'clock on the following Wednesday evenings during the present session:—March 14.—"The Type Printing Apparatus employed by the Exchange Telegraph Company," by F. Higgins, Member of Council; March 28.—"On Underground Wires," by Willoughby Smith, Member of Council; April 11.—"On Quadruplex Telegraphy," by Geo. B. Prescott, of the Western Union Telegraph Company, New York; April 25—"On Batteries," by Martin F. Roberts, F.C.S.; May 9—No paper yet fixed.

PHYSICAL SOCIETY—17TH FEBRUARY, 1877.

Prof. W. G. ADAMS, Vice-President, in the chair.

MR. T. W. PHILIPS, C.E., was elected a member of the Society.

PROF. GUTHRIE exhibited for Mr. C. J. Woodward an apparatus he has devised for showing to an audience the interference of transverse waves. A light frame, capable of moving in a vertical plane, carries a horizontal strip of tin about two feet in length, cut in the form of the ordinary sine wave, and which supports by means of a roller, a light wooden block, carrying an ink recorder in front of a sheet of paper. This block slides in a vertical slot in a piece of wood, which can be moved horizontally, supported by a roller on another similar strip of tin, fixed parallel to the first, and vertically below it. The movable frame rests on a castor attached to this block. If the relative positions of the waves be now varied and the blocks moved along them, the path traced by the ink recorder will represent the wave due to their combination.

MR. S. P. THOMPSON exhibited some galvanometers in the form of magic lantern slides, which he has arranged for exhibiting their indications to an audience. A gold leaf electroscope of this form was capable of detecting very small charges of statical electricity.

MR. WILSON then showed an arrangement for exhibiting convection currents in heated water. It consists of a small glass cell with parallel sides. In the base of the wood dividing the sides is cut a slight depression, to expose a brass tube which traverses it horizontally, and is open at one end, while the other is bent at right angles, and connected with a flask containing water. The brass tube where it is exposed in the cell is surrounded with a jelly formed of gelatine, containing rose aniline, and the cell is filled with water and projected on the screen. When the tube is heated by boiling the water in the flask, the jelly is liquified, and the liberated colouring matter rises in the water, showing the direction of the heated current.

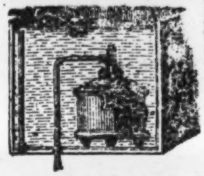
PROF. GUTHRIE exhibited an arrangement he has been using with a view to determine the vapour tension of water, and explained the difficulties to which such a determination is liable, and the manner in which his apparatus has so far failed. It was shown that a crystal of alum, or a saturated solution of salt, when introduced into the Torricellian vacuum, depresses the mercurial column less than pure water, whereas a solution of size, gum arabic, or any colloid, depress it to precisely the same extent. It thus appears that water in its different states of combination has different vapour densities, and their determination requires an arrangement in which the several substances can be easily introduced into the Torricellian vacuum, and very slight changes of the level of the mercurial column can be ascertained. He then showed the manner in which electricity is distributed on non-conductors, such as the plate of an electrophorus, by placing it for a given time beneath a point connected with a charged Leyden jar, and subsequently sprinkling a mixture of sulphur and litharge over it. It was shown that the diameter of the circle formed below the point after the superfluous powder had been removed is not purely a function of the distance between the point and the plate, but is mainly influenced by the conductivity of the material, and further, that if the point be directed obliquely towards the plate, the circle formed is very slightly eliptical, but the elipticity is in no degree proportionate to the obliquity of the point; and finally, he showed that if the non-conducting plate of an electrophorus be written upon with a metal and sprinkled with the above mixture of sulphur and litharge, the former or latter adheres according to the nature of the metal used.

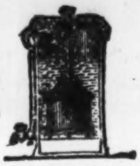
The London and General Water-Purifying Company

LIMITED,

PATENT CISTERN FILTERS CHARGED SOLELY WITH ANIMAL CHARCOAL.

House Cistern fitted with a Cistern Filter





Requiring when once fixed, no attention whatever,

And Superior to all others. *Vide* Professor Frankland's Reports to the Registrar-General, July, 1866; November, 1867; and May, 1870; the *Lancet*, January 12, 1867, and Testimonials from Dr. Hassall, September 23, 1863; Dr. Letheby, February 15, 1865, and December, 1872.

Price £1 10s. and upwards. PORTABLE FILTERS on this System, £1 5s. to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales at Sandringham; by H.R.H. the Duke of Cambridge, the *elite* of the Medical Profession, and at the London, St. George's, Fever, and German Hospitals, and various Lunatic Asylums Institutions, Breweries, &c.

Pocket Filters, 4s. 8d. & 6s. each. Household & Fancy Filters, from 12s. 6d.

WATER-TESTING APPARATUS, FOR DETECTING THE IMPURITIES IN WATER, 10s. 6d. and 21s. each. Danchell's Testing Apparatus for Discovering the Presence of Impurities in Water," is a most convenient and portable one.—*Vide* Dyke on the Preliminary Duties of Health Officers.

This is a very handy case for the Study Table or the Carpet Bag. It contains the Chief Chemical Tests for Qualitative Water Analysis, and will be found of use by medical and other men who may have occasion to ascertain in a ready manner whether any of the more actual impurities are present or not in water.—*Vide* the *Medical Record*, January 29, 1873.

157, STRAND, W.C. (*four doors from Somerset House*), LONDON.

Read—" Water: its Impurities and Purifications," price, per post, 2d

---

THE

TELEGRAPHIC JOURNAL

AND ELECTRICAL REVIEW.

Handsomely bound in cloth, gilt, Vols. I., II., III., and IV., now ready. Price 10s. 6d. each. Nearly all the back numbers may be had through any Bookseller or of the Publishers. Subscribers' numbers bound in black cloth, gilt, 2s. 6d. Binding Cases, 2s.

HAUGHTON & Co., 10. PATERNOSTER ROW, E.C.

ZANNI'S PATENTS.

MAGNETIC AND ELECTRIC TELEGRAPH WORKS,

1, JAMES STREET, OLD STREET, CITY ROAD.

Zanni's Magneto-Electric Bell-Pull, dispensing with the use of Battery.

Zanni's Magneto and Electric Alphabetical Dial Instrument.

Zanni's Patent Morse Instrument to work without Battery.

Zanni's Magneto-Electric Block system to work without Battery.

Zanni's Ship Signal Dial to work without Battery.

BENNETT'S BATTERY, with latest improvements, specially recommended on account of its simplicity, cheapness, and durability.

All kinds of Electric Bells, Buttons, Indicating Tablets, with the latest Improvements.

The above Instruments of the best make 20 per cent. less than any other House

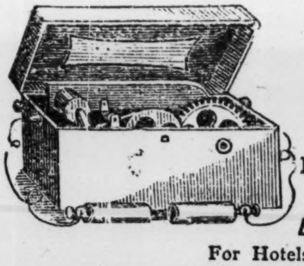
MANAGER, E. D. BRIDGER. CONSULTING ELECTRICIAN, G. ZANNI

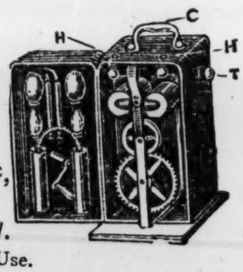
City Offices: 18, Bull and Mouth-street, St. Martin's-le-Grand, E.C.

M. SADLER,

INVENTOR OF THE

UPRIGHT MAGNETIC MACHINE,





So universally used by the Medical Profession,

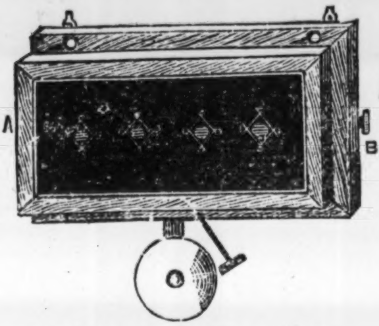
MANUFACTURER OF

Electrical, Galvanic, Magnetic, Chemical, Photographic, and Pneumatic Apparatus.

ELECTRIC BELLS AND INDICATORS, OF EVERY DESCRIPTION.

For Hotels, Warehouses, Manufactories, Mines, and Domestic and General Use.

19, ASTON STREET, BIRMINGHAM.



ELECTRIC BELLS

On an Improved System.

BELL BATTERY WIRE AND COMMUNICATOR

Complete Apparatus sent carriage free to any railway station in England for £1 2s.

Youth's Magic Lantern and 12 Slides, 7s. 6d.
Youth's Microscope and 12 Objects, 9s. 6d.
Youth's Case of Drawing Instruments, 9s. 6d.
Youth's Telescope, long range, 5s. 6d.
Youth's Binocular Glass, 9s. 6d.

All carriage free as above for One Shilling extra.

PRICE LISTS FREE. STATE ARTICLES REQUIRED.

J. W. E. ARCHBUTT,
8 BRIDGE STREET, WESTMINSTER, LONDON.
FACING HOUSES OF PARLIAMENT.

THE TELEGRAPHIST:

THE ORGAN OF THE BRITISH TELEGRAPH STAFF.

MONTHLY, 2d.; POST FREE FOR SIX MONTHS, 1s. 3d.

Telegraphic Tales, Poetry, Anecdotes, Correspondence, Letters from Abroad, Notes, English and Foreign Articles, and other matter interesting to Telegraph Clerks.

Orders addressed to the Editor, Central Telegraph Station, London, promptly attended to.

N.B. A Course of Popular Instruction in the various instruments in use, with diagrams, is now being published.

IMPORTANT NOTICE!!

"NATURE,"

For MARCH 8, will contain a Portrait engraved on steel, by C. H. JEENS, of

HERMANN HELMHOLTZ,

THE EMINENT GERMAN PHYSICIST,

With a Notice of his Life and Work by Prof. CLERK MAXWELL, F.R.S.

DOUBLE NUMBER, Price EIGHTPENCE, By Post EIGHTPENCE HALFPENNY.

OFFICE—29, BEDFORD STREET, STRAND, W.C.

ELECTRIC BELLS.

HOTELS, CLUBS, & PRIVATE HOUSES in Town and Country FITTED with

ELECTRIC BELLS, SPEAKING TUBES, THIEF DETECTORS, &c.

The Trade and Amateurs supplied with Stores. Price Lists on application. Batteries and other Electrical Goods.

EDWARD J. PATERSON,
3, BEDFORD COURT, COVENT GARDEN, W.C.

THE

DIRECT UNITED STATES CABLE CO., LIMITED.

REDUCTION OF TARIFF.

On and after the 1st of March, 1877, the rate for Telegrams to NEW YORK and CANADA will be reduced to

ONE SHILLING PER WORD.

The name of the place from which messages originate will be transmitted free of charge.

The name of the place to which messages are destined will be transmitted free of charge.

The registered name of the firm or person to whom messages are to be delivered will be transmitted free of charge.

This Company will continue to effect registrations of names and addresses by cable free of charge.

For rates to other places, and further particulars, apply at the Company's Offices.

STATIONS:

Head Office:—34, Throgmorton Street, London, E.C., (always open).

BRANCH OFFICES:—Southsea House, adjoining the Baltic, Threadneedle-street, E.C.; East India Avenue, Leadenhall-street, E.C.; the Commercial Sale Rooms, Mincing Lane, E.C. LIVERPOOL OFFICE:—D 6, Exchange Buildings (always open).

GENERAL OFFICES—Palmerston Buildings, Old Broad-street, London, E.C.

26th February, 1877.

CROWN TELEGRAPH WORKS CO.,

F. R. FRANCIS, T.E., Superintendent and Engineer,

S. MONTEFIORE, M.S.T.E., Managing Director.

OFFICES: 85 & 52, HATTON GARDEN, E.C.

Telegraph Engineers & Manufacturers of—

BATTERIES,
INSULATED WIRES,
TELEGRAPH INSTRUMENTS,
ELECTRIC BELLS,
LIGHTNING CONDUCTORS, &
GENERAL STORES.

THE TRADE SUPPLIED. CATALOGUES FREE.

WHOLESALE AND EXPORTATION.

PATENT ELECTRIC PEN.

For the production of manifold copies of Writing, Outline Drawings, or Designs. Any Penman can use it. ONE TO TWO THOUSAND COPIES are easily and rapidly produced. No special paper is required. It is cleanly and prints with ink of any colour. It obviates the expense and delay of lithography, and from the perfect privacy and promptitude with which copies can be made it is of the utmost value to Bankers, Merchants, Stock Brokers, Solicitors, Accountants, Ship Brokers, and Secretaries of Public Companies.

Price of Pen with Duplicating Press, £8 8s. It may be seen in operation at the Offices of

THE ELECTRIC WRITING COMPANY, 9, NEW BROAD STREET, E.C.

SANDERSON & PROCTOR'S

PATENT SOLID COPPER TAPE

LIGHTNING CONDUCTOR

Is the **NEATEST, MOST DURABLE,** and **EFFICIENT** safeguard against lightning. Prices from One Shilling per foot complete for fixing. Estimates on application.

SANDERSON & PROCTOR, 19 & 21, Queen Victoria Street, London, E.C. Works, Huddersfield.

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS COMPANY, LIMITED.

Offices and Warehouses: 106 and 100, CANNON ST., LONDON, E.C.
Works: SILVERTOWN, ESSEX; PERSAN BEAUMONT, FRANCE.

TELEGRAPH ENGINEERS AND MANUFACTURERS OF

CABLES.—Submarine, Subterranean, and Aerial.

WIRE.—India Rubber and Gutta-Percha covered in all gauges.

INSTRUMENTS.—"Morse" Inkers, Single Needle, Wheatstone's Alphabetical, Semaphore "Block" Instruments, Bells, Resistance Coils, Sir W. Thomson's and other Galvanometers, Condensers, Testing Instruments, &c.

BATTERIES.—SOLE MANUFACTURERS FOR GREAT BRITAIN, IRELAND, AND THE COLONIES OF THE CELEBRATED LECLANCHE BATTERY, which has received the most favourable reports from the Postal Telegraph Authorities and other eminent Telegraph Engineers, and is now in general use by the Post Office and English and Continental Railways. As a Battery for all Telegraphic purposes it is undoubtedly pre-eminent. All other kinds of Batteries also manufactured. Ebonite Cells, Carbon Plates, &c.

INSULATORS.—Ebonite, Porcelain, Brownware, &c.

MANUFACTURERS OF THE MOST IMPROVED APPARATUS FOR RAILWAY BLOCK-SIGNALLING, SEMAPHORE REPEATERS, "LIGHT" INDICATORS, AND WALKERS "PASSENGER AND GUARD" COMMUNICATOR.

TELEGRAPH STORES AND APPARATUS OF EVERY DESCRIPTION.

TORPEDO APPARATUS.

THE INDIA-RUBBER, GUTTA-PERCHA, & TELEGRAPH WORKS COMPANY (Limited) are Patentees and Manufacturers of a Complete System of Torpedoes for Harbour and Coast Defence, and of the

SILVERTOWN PATENT FIRING BATTERY,

A CONSTANT BATTERY FOR MINING AND BLASTING PURPOSES.

CONTRACTS ENTERED INTO for the SUPPLY, CONSTRUCTION, and MAINTENANCE of TELEGRAPH LINES.

CHRISTMAS AND NEW YEAR'S DAY.

By KUKLOS.

Published December 23, a London Edition of the above, with a Special Preface. Price 1s. 6d.

Recently published, by the same Author,

Part First of the Series on Physical Science, entitled

CENTRIFUGAL FORCE AND GRAVITATION. Price 4s.

Also

THE MEASUREMENT OF THE SUN'S DISTANCE,

EXPLAINING THE SEVEN NEW METHODS.

(Being Part Fifth of Lectures on Astronomy.) Price 2s. 6d.

Book First of the London Edition of

THE GEOMETRICAL TREATISE ON THE LINEAR CORRELATIONS OF

THE CIRCLE AND STRAIGHT LINE.

By JOHN HARRIS, is now published.

Book Second will be ready in a few days.—Price 2s. 6d. each book.

London: TRUBNER & Co., Ludgate Hill.

LONDON: PRINTED FOR THE PROPRIETOR BY JOHN PENDLEBURY, AT THE CHILDREN'S HOME, BONNER ROAD, E.—MARCH 1, 1877.